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Oats for Tomorrow

The Scots and the Irish and a few other peoples are fond of their oats, otherwise this cereal of cool lands plays a small role in the human dietary. Although the oat plant was known to the ancients, on a global basis it overwhelmingly serves as a feed for livestock and poultry. This situation may change, however, as prudent men look to the needs of tomorrow. For the world needs protein, the nutrient that is most costly and in shortest supply. Oats can make a vital contribution toward meeting this need.

Some cereals are markedly superior to others in protein content. With an average protein content of 17 percent, cultivated oats easily top the list. Moreover, their balance of amino acids, the so-called building blocks of protein, while slightly inferior to foods of animal origin is the best of all commercially grown cereals. Oats are especially rich in the limiting amino acid lysine, whose concentration in the protein of other cereals is about 3 percent; the figure for oats is 4 percent and more.

Heartened by these inherent qualities, ARS scientists are working to make a good food even better. A major approach centers on screening cultivated and wild oats to find those with more protein and a better balance of amino acids. Last year the scientists ran chemical analyses on 24,000 samples of commercial oats. They also screened 11 species of wild oats and found them to have an average protein content of 27 percent. A few specimens ran as high as 37 percent. Although the wild species are unfit for commercial use because of poor agronomic traits, they do provide valuable germ plasm for raising protein levels. So far, unfortunately, screening tests have not uncovered any candidate species with superior balance of amino acids.

Accordingly, ARS scientists are cooperating with other breeders toward the goal of genetically raising the protein content of new oat varieties to 20 percent. They know that protein levels in oats can be increased without impairing amino acid balance, a problem that besets breeders of barley and wheat. In other research, scientists are trying to increase the protein of oat crops by developing improved cultural practices for growers, especially skills involving tillage and use of fertilizers.

It will take several years of painstaking research to bring envisioned progress to reality. In time, oats could become a more valuable food—an encouraging prospect for mankind as the world struggles to banish hunger.

Editor: *R. P. Kaniuka*
Editorial Assistant: *M. J. Phillips*

Contributors to this issue:

R. C. Bjork, V. R. Bourdette, J. P. Dean, P. L. Goodin, M. C. Guilford, G. B. Hardin, M. E. Nicholas, M. S. Peter, D. H. Senft, D. M. Webb

COVER: Bio-aide Mary Caterson places wax moth larvae (*Galleria mellonella*) into jars containing tiny parasitic wasps, *Brackermeria intermedia*. In nature, this species oviposits in the pupae of gypsy moths. Under laboratory conditions, however, large numbers of parasite progeny can be built up by using the pupae of wax moths, which are easier to raise. Parasitized wax moth larvae are removed from these jars every three or four days and taken to greenhouses where they hatch, are collected by vacuum, and released in nature or shipped to cooperating agencies in other States (0673A1105–24). See story on p. 3.

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Earl L. Butz, Secretary
U.S. Department of Agriculture

Talcott W. Edminister, Administrator
Agricultural Research Service

The looming biological battle

The wasp parasite, Coccygomimus, *ovipositing in a gypsy moth pupa (0673A1110–16).*

GYPSY MOTHS would beat their wings in despair, if they knew what kind of a future is being planned for them. Insects that eat gypsy moths, diseases that attack their larvae, and other approaches are under test in cooperative Federal-State research and regulatory efforts against this destructive pest of Northeastern forests.

Since the early 1900's, efforts to stop the gypsy moth with insecticides have produced environmental pollution with only temporary successes. Last year alone, gypsy moths defoliated about 1.4 million acres of forest and orchards in the United States.

Gypsy moths inflict much less damage in Asia and Europe where they are attacked by some 100 species of parasities and predatory insects. Federal and State entomologists hope to bring similar biological pressure to bear against the gypsy moth here.

ARS entomologist John J. Dreá, Jr., and his associates stationed at Sevres, France, are collecting the most promising European parasites of the gypsy moth. Last year, Dr. Dreá shipped 5,639 parasitic flies and wasps to the ARS insect quarantine laboratory at Moorestown, N.J.; he plans to ship another 5 or 6 thousand this year. Last year, cooperators in Asia also supplied parasites and more are expected. Field and laboratory studies abroad, of course, must first demonstrate that the parasites are harmless to man, plants, and animals other than gypsy moths.

The Moorestown laboratory makes sure that these beneficial insects carry no undesirable hitchhikers with them. Unfortunately, even beneficial parasites have parasites of their own, called hyperparasites. Moreover, some of the beneficial parasites may be diseased. Releasing unhealthy insects could wreak havoc in U.S. biological control programs involving parasites released earlier, if the disease or hyperparasite spread and destroyed other beneficial insects which attack various kinds of pests.

After ARS entomologists George W. Angalet and Lawrence R. Ertle at Moorestown certify the safety of the imported parasites, most of them are

Dead pupae of gypsy moth show signs of the cause of their demise—a round hole through which parasitic wasps emerged (0673A1110–22).

Biologist Dan J. Palmer of the New Jersey Department of Agriculture, Trenton, inspects descriptions packed with vials of gypsy moth parasites as they arrive from Moorestown. These particular parasites will be introduced into "stringing" jars containing gypsy moth larvae of various instars to determine host preference, behavioral patterns under controlled laboratory conditions, and other factors necessary to begin mass rearing (0673A1105–11).

shipped to other Federal and State entomologists for distribution to points where they can fight gypsy-moth infestations. ARS entomolgists at the U.S. National Museum, Washington, D.C., provide assistance in identifying parasites.

The New Jersey Department of Agriculture has received the bulk of the Moorestown stock. At Trenton, two State laboratories are conducting mass-rearing and ecological studies of 13 species of parasites obtained from Moorestown. This cooperative program is partly funded by USDA's Animal and Plant Health Inspection Service.

The Trenton entomologists, headed by William W. Metterhouse, New Jersey's deputy director of plant industry, also reared for distribution about 1 million progeny of seven species obtained from the Moorestown laboratory in 1972. Entomologists in New Jersey and eight other States have released many of these parasites into the field as well as one species of predator.

When released, the parasite "troops," like a human army, have different tac-

Hair-like structures of the gypsy moth caterpillar (larvae) are designed to foil attack from parasites. This tiny parasitic fly (Palexoresta)*, however, has found an opening through the defenses as she prepares to thrust her organ into the caterpillar and deposit her eggs (0673A1109–15).*

Supervisory inspector Roger Bullock of the New Jersey Department of Agriculture releases parasitic wasps reared in the laboratory. Mr. William Metterhouse, deputy director of plant industry for New Jersey, holds cartons containing several hundred additional parasites. These wasps will seek out the pupae of gypsy moths and deposit their eggs in the pupae. Other wasp species attack the eggs and caterpillars of gypsy moths (0673A1108–22).

ARS technicians Sue Barth and Al O'Brien observe effects of larval parasites on gypsy moth larvae. Larvae are collected in nature in areas where parasites have previously been released. The larvae will be held in these small containers until parasites emerge or the larvae pupate—thus giving researchers an indication of the imported parasites' success rate (0673A1104–21).

tics and targets. Infantry, cavalry, and artillery have their counterparts among parasites. Thus, in the early stages of a biological control battle, entomolgists might release several "regiments" of parasitic wasps, such as *Apanteles melanoscelus*. Like artillery, these wasps "soften up" the enemy, resulting in a greater impact from later attacks by other parasites.

The *Apanteles* wasp, for example, hunts one specific target: the gypsy moth caterpillar. After sizing up its prey, the wasp pounces on the caterpillar, and with a thrust of its egg-laying organ quickly deposits an egg inside its victim. Each wasp can thus parasitize more than 100 caterpillars, which stop feeding and die within a week after the wasp larvae hatch inside them. The wasp larvae destroy their hosts' vital organs, emerge from the dead insects, and spin their cocoons. Other wasp species attack only younger caterpillars; still others prefer older caterpillars.

A second phase of this biological war involves parasites that employ still other tactics. For example, *Brachymeria intermedia* wasps zero in on the pupae (cocoon stage) of the gypsy moth. The searching behavior of these wasps leads them beneath tree bark and into other concealed places, where the caterpillars spin their cocoons.

The final attack comes when surviving adults emerge from their cocoons, and lay their eggs in midsummer. The eggs lie dormant until the next spring, providing ample time for *Ooencyrtus kuwanae*, a tiny Japanese wasp, to attack them during warm days.

Another strategy in this biological battle involves insect diseases. An experimental virus of the gypsy moth was recently obtained from the Insect and Disease Laboratory that USDA's Forest Service operates in Hamden, Conn. So far, this virus can only be produced from infected insects. But if Beltsville scientists succeed in rearing it in test tube cultures of insect cells, they will be able to synthesize pure strains in large quantities.

From the gypsy moth's standpoint, perhaps the meanest of all biological assaults involves the sex attractant of the female moths. A synthetic form of this attractant lures the males to traps or so confuses them in their search for mates that they die of exhaustion before realizing their life mission (AGR. RES., November 1970, pp. 8–9). Accordingly, the unmated females lay only infertile eggs, setting off a population decline.

In time, biological methods such as these may greatly reduce the gypsy moth's present destructive force and relegate it to the status of a minor pest, as it is in Europe and Asia. □

This New England forest in midsummer attests to the voracious appetite of legions of gypsy moth larvae (0770C682–30).

Widespread defoliation by gypsy moth caterpillars destroys the food sources of wildlife as well as the natural habitat of plants and animals. Further destruction can be caused by the gypsy moth's "camp followers"—other insect pests and plant diseases—which exact a heavy toll on weakened trees. Unprotected by foliage, the trees and forest floor dry out, creating fire hazards. Such fires result in even greater environmental pollution and destruction than the direct damage caused by the caterpillars. Even when fires do not occur, trees may die if defoliated 2 years in a row—especially if summers are dry.

Gypsy moth depredations have been spreading for about 100 years, beginning shortly after an amateur entomologist introduced a colony of the moths into Massachusetts from France. He intended to crossbreed them with silkworms to obtain a superior strain for the silk industry.

Not only did the experiment fail, but gypsy moths escaped. In the absence of natural enemies, the pests thrived. Some years passed before State and local control officials assessed the menace. By that time, the gypsy moths had become established in New England. Their outbreaks periodically reached alarming proportions, but the moth was brought under temporary control by sanitation procedures and inorganic insecticides. Control became easier when DDT came into general use, after 1945.

When use of DDT was discontinued, the gypsy moth spread rapidly into the Middle Atlantic States. It is now extending its range southward along the Appalachian range, and small infestations have been reported in the Midwest.

Foiling Eurasian Watermilfoil

EURASIAN WATERMILFOIL—an exotic aquatic weed with high reproductive potential, wide ecological range, and a bad reputation in the United States—may soon encounter two old enemies here.

ARS-sponsored Yugoslav work has resulted in finding two promising insect candidates for biological control of this plant: a moth (*Parapoynx stratiotata*) and a weevil (*Litodactylus leucogaster*).

Eurasian watermilfoil (*Myriophyllum spicatum*) is a native plant of Europe, Asia, and parts of Africa. In the U.S., it poses a threat to navigation, irrigation, wildlife, and fish ranging from upstate New York, Chesapeake Bay to Florida, and Texas. It has also been found in Washington and Alaska.

Entomologist Lloyd A. Andres, ARS-cooperating scientist, Albany, Calif., says the use of watermilfoil's natural enemies offers a practical approach to the problem. "Control of the plant with chemicals is often expensive and of short-term value," Dr. Andres says.

"Alternatively, restraining the spread of *M. spicatum* by mechanical removal of the plant does not provide a long-term solution, since the plant can spread by the rhizomes remaining in the soil and from portions of fragmented stems, producing a still more dense green mass. Ultimately, the control of this plant may depend on the integration of biological, chemical, and mechanical control methods utilized in such a way as to provide for a quality environment."

In their work on *P. stratiotata* and *L. leucogaster*, the Yugoslav scientists found that *stratiotata*, when confined, feeds sparingly on other aquatic plant species; however, when offered a choice between these and its regular host plant, *stratiotata* larvae prefer Eurasian milfoil. On the other hand, the *Litodactylus* weevil is host-specific to Eurasian milfoil, but consumes less of the plant than does *stratiotata*. Adults and larvae feed mostly on the generative parts of the weed, damaging both male and female flowers and destroying the seed. This inhibits normal fertilization processes, and reduces the plant's ability to reproduce and spread by seed.

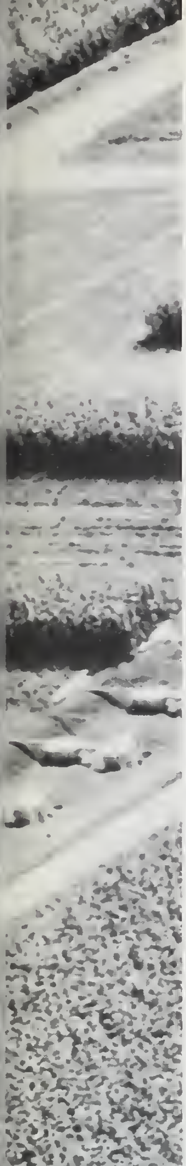
ARS scientists are not ruling out *L. leucogaster* because of its limited consumption of Eurasian watermilfoil. Indeed, they are requesting that both species of predators be introduced into the USDA-Florida cooperative biological quarantine facility, Gainesville, for further study.

In addition to the search for effective predators, the Yugoslav project also scanned the field of pathogens. They did not find an acceptable pathogen, but in their search, discovered that milfoil is a host for fungi of the genus *Fusarium*. This includes species of importance to agricultural crops. Conceivably, milfoil may harbor various fungal infections of economically important plants.

Dr. Andres says that the search for pathogens needs to continue. Also, he concurs with principal investigator, Dr. Mladen Lekic: "If various ecological management techniques are to be employed in the control of milfoil, additional studies of the microecological conditions of the plant's habitat are needed."

Although the milfoil is widespread, its presence and abundance in some lakes and rivers appears to be limited by unknown environmental factors. Entomologists need to know why.

This project was conducted under the provisions of Public Law 480 at the Institute for Plant Protection, Beograd. □



CULTIVATION MAY SAVE SOIL

REPLACING the time-honored cultivation of corn with modern chemical weed control on plowed seedbeds may often be an unprofitable decision.

In a 4-year study (1966–1969) on a Midwest claypan soil, 50 percent more soil was eroded from chemically-treated corn plots than from cultivated plots in 2 wet years. During the other 2 years, when rainfall was about normal or below normal, the uncultivated plots lost four to eight times as much soil, and two to four times as much water.

Moreover, corn yields averaged 27 bushels per acre more on cultivated plots during the driest year. In the wetter years, scientists found that neither weed control method contributed to significantly different yields.

ARS scientists who carried out the experiments, which were in cooperation with the Missouri Experiment Station were hydrologic technician Fred D. Whitaker and hydraulic engineer Herman G. Heinemann, Columbia, Mo., and statistician Walter H. Wischmeier, Lafayette, Ind.

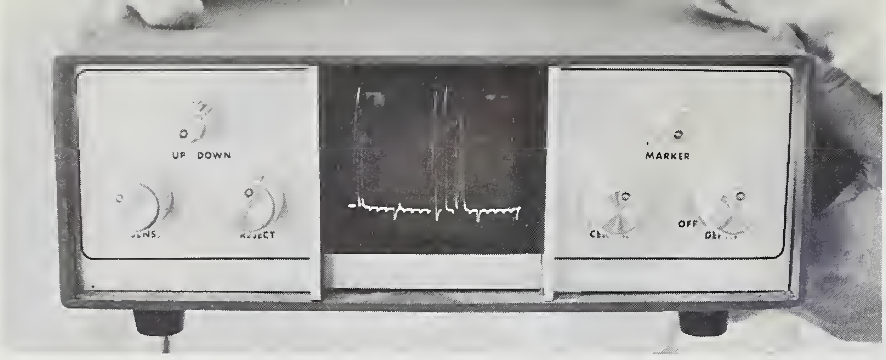
The experimental plots near Kingdom City, Mo. had been in continuous corn, adequately fertilized, for 8 years before the study. The land, Mexico silt loam, has a 3 percent slope and is similar to about 10 million acres of cropland in the Midwest.

How effective cultivation can be in reducing runoff and soil loss depends greatly on timing cultivations in relation to crust-forming rains. When soil crusts were reformed by intense storms soon after cultivations, runoff for the remainder of the year from cultivated and uncultivated corn was nearly equal.

Reduction of soil loss in cultivated plots occurred over most of the growing season—ascribed mainly to the tillage-related benefits of increased infiltration and reduced runoff velocity. This reduction, however, could not be entirely attributed to cultivation. During the wet seasons, light to moderate growth of annual grasses cut soil loss in scattered locations, whereas the growth of volunteer grasses on chemically-treated plots was skimpy.

Precipitation in inches in four corn-growing seasons was 16.72, 12.83, 27.83, and 39.73. Runoff prevented through cultivation instead of chemicals to control weeds was 0.57, 1.67, 2.10, and 1.59 inches, respectively, as measured by the lysimeters in the photo.

Corn yields in these tests averaged 8 bushels per acre more on the cultivated plots. Apparently, retention of even small amounts of soil water during dry years by reducing runoff provides extra moisture during critical silking and ear development, thus significantly increasing yields. Since most rains during drier seasons occur as intense storms, maintenance of high rates of water infiltration into a soil is vital. Research is continuing with chemical weed control in conjunction with tillage and other management practices in an effort to reduce both farm costs and soil erosion. □



This closeup of a cathode ray screen shows the reading of a pregnant sow (PN-2837).

Ultrasound detects pig litters

THE INABILITY of producers to identify sows that have failed to conceive has been a major barrier to efficient swine production. A new method of pregnancy detection now promises to help solve this problem.

Developed cooperatively by ARS and the University of Illinois, an ultrasound technique is used to distinguish pregnant from non-pregnant sows as early as 30 days after conception.

Caring for sows that are thought to be pregnant, but in fact are not, is costly to producers in feed, labor, and investment in facilities and equipment. It costs about 30 cents per day to feed a gilt, plus at least 15 cents per day for other costs, whether or not she is pregnant. Even under the best conditions, 20 percent of all gilts fail to conceive on first service, and 8 to 10 percent are permanently sterile. Producers could save money by not having to wait until farrowing time to find out if a sow is pregnant.

Using ultrasound, a producer can separate pregnant sows from non-pregnant "freeloaders," allowing him to sell or rebreed the non-pregnant sows. This selection enables him to make more effective use of his breeding facilities and to plan more adequately for farrowing, nursing, and finishing.

Detecting pregnancy with reflection-echo ultrasound requires a 6-pound, hand-held ultrasonic analyzer with a cathode ray screen. Attached to the analyzer is a probe, which emits and receives high-frequency sound. Total cost of the analyzer is about $1,200. To reduce costs, several small producers could share an analyzer or a veterinarian could purchase the equipment and charge producers a custom fee.

When testing a sow for pregnancy, a few drops of corn oil are placed on the tip of a probe, which is then touched to the lower flank of the sow, about 5 centimeters behind the navel and just outside the nipple line. The probe generates and picks up reflected sound from the fluid surrounding the fetuses in the uterus of a pregnant sow. These echoes appear on the right side of the cathode ray screen. Echoes from the body wall of non-pregnant sows appear on the left side of the screen.

The sow should be in a standing, fairly relaxed position. Hunched-up or lying-down positions may give false results. One man can check a sow, but two make the job easier. The test takes only a few seconds. Since results are visible on the screen, skilled or experienced help is not needed to interpret the readings.

In recent field tests on several thousand sows, physiologist Philip J. Dziuk, University of Illinois, Urbana, found that the analyzer approached 100-percent accuracy in picking out pregnant and non-pregnant sows.

The ultrasonic technique for detecting pregnancy in livestock was developed by ARS nutritionist Ivan L. Lindahl, Beltsville, Md. His pioneering research provided the general principles on which this swine-pregnancy detection method is based.

The intrarectal doppler probe developed by Dr. Lindahl for use on sheep (AG.RES. June 1969, page 5) does not work well on swine. Squealing of the animal interfers with the ability of the

operator to hear the reflected sound, and pregnancy cannot be detected until it is at least 50 days along.

Intrarectal probes also appear to irritate the rectum of the sow and increase rectal prolapse. Anesthetization of sows eliminates these problems and provides accurate results, but this procedure is neither as rapid nor as cheap as the ultrasound method.

Cost of testing swine by the newer method is about $2 per head when done on a custom basis. Cost per sow by owners of testing units depends on the number of animals tested—in large herds, it could be less than the cost of feed for one day. In a herd of 100 sows, if 20 were not pregnant and feed costs were $21 per sow from day 30 to day 100, feeding costs alone for these 20 sows would be $420.

Many ultrasonic pregnancy analyzers are currently in use by both veterinarians and producers throughout the country. □

Dr. Dziuk and research assistant Nahid A. Shahabi demonstrate how the ultrasonic device is used for detecting pregnancy (PN–2838).

Crude soap recovers mercury from water

CHALK UP another advance in the complex war on water pollution. Chemist Walter H. Schuller of the ARS Naval Stores Laboratory, Olustee, Fla. has found that several naval stores products are effective in reducing the mercury content of water to well below the 5 parts per billion (ppb) now permitted in drinking water. The most effective product is crude black liquor soap, a 3-cent-per-pound byproduct of the kraft paper process.

There are several means for removing large amounts of mercury from industrial effluents but removal below 100 parts of mercury per billion parts of water has proved both difficult and costly.

The new treatment employs the soap in very small quantities. The soap is derived from the kraft process where wood chips are cooked to release the cellulosic fibers for use in paper making.

In treating mercury-laden water, the black liquor soap is added to the water and mixed well during which time an emulsion forms and water insoluble mercury salts of the soap result. The emulsion is then broken by acidifying the solution and the solids containing the mercury are filtered out.

The recovered sludge can be handled in several ways. It can be buried or the mercury recovered by treatment with acid, or the mercury containing products can be added to copper tallates or resinates. The latter procedure is preferred because the tallates or resinates can then be further used as fungicides in marine anti-fouling paints, wood preservatives, and other products instead of becoming yet another disposal problem. □

The healing bath

It's not all hot-air for Louisiana sugarcane growers if they rely solely on this method to remedy mosaic and ratoon-stunting disease in their crop.

Plant physiologist Gerd T. A. Benda's experiments at the U.S. Sugarcane Field Station at Houma, La., show that a modification of the hot-water treatment may provide the first commercially feasible, simultaneous cure for both the extremely virulent sugarcane mosaic disease and ratoon-stunting disease, which affects the second- and third-year crops growing from stubble.

In all heat treatments, air or water, the temperature and time required for cure is near the lethal point. The longer the treatment, the higher the temperature and the greater the mortality. As for the virus, so for the host. It may be a case of "the operation was a success but the patient died."

"This impasse between choosing between remedy or survival is the single most important factor limiting the application of heat treatment to treat sugarcane diseases," Dr. Benda says.

Hot-air treatment has a higher survival rate, but does not cure mosaic. It also involves technical difficulties. (1) The oven must run at a constant temperature. (2) There must be an even flow of air throughout the oven. (3) It is hard to evaluate temperature effects

Dr. Benda in greenhouse inspecting cane plants grown from heat-treated cuttings for indications of mosaic disease (0673X1241–15).

from outside air temperature to inside plant temperature. (4) The low heat capacity of air requires time-consuming treatments.

Dr. Benda's method involves immersing cuttings and whole stalks for 20 minutes in water circulating at temperatures of 52° C. on the first day and at 57.3° C. on the second and third days, successively. More "patients" lived and more were cured. For the first time, 90 percent of the infected buds were cured simultaneously. There was little or no survival problem.

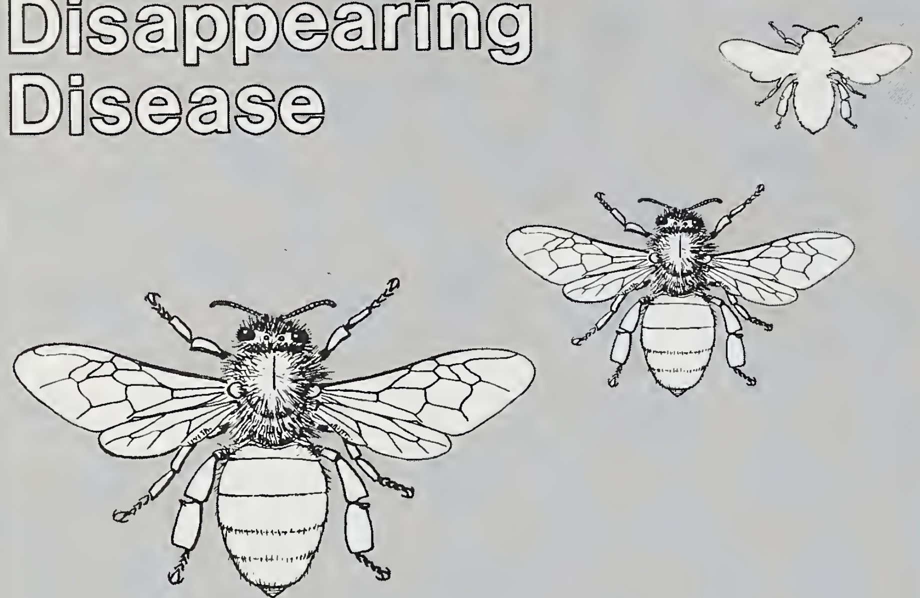
In the future these results may lead cane growers to turn down the oven and fill up the bath. □

Dr. Benda records observations of constant temperature water-bath used in lab analysis. Here, cane cuttings are immersed in circulating water for varying tme periods, at temperatures varying from 52°C. to 57.3C. This "thermotherapy" technique is used in curing mosaic disease. After hot-water treatment, cuttngs are planted in a greenhouse, and shoot is grown for about 3 months, the plants being inspected frequently for signs of the disease. The data developed in the lab will later be applied to commercial processing on a large scale in high-volume water-bath tanks (0673X1241–9).

Closeup of an infected cane bud with ratoon-stunting disease. This cane is variety CP44–101, a standard variety for studying stunting disease (0673X1242–2).

Dr. Benda showing comparison of healthy cane (top), and mosaic disease (bottom). Top plant was from cutting that had been heat-treated, bottom plant had not been treated (0673X1242–9).

Disappearing Disease



...a longevity problem?

CAN THE CRIME be solved without the corpus delecti? Southern beekeepers are still faced with so-called "disappearing disease," a calamity which cost beekeepers in Louisiana and Texas thousands of dollars in lost honey bees (*Aphis mellifera*) during the 1960's. In the fall and winter the colonies literally vanish, leaving no dead bodies and no clues.

Entomologist Norbert M. Kauffeld, at the ARS Bee Breeding Investigations Laboratory in Baton Rouge, La., maintains that on the basis of present research there is, in fact, no "disease." Because so-called "disappearing disease" occurs during winter when brood rearing is reduced and foraging is continuous, the adult honey bees are not being sufficiently replaced by young bees and are dying of old age.

In the warm South the foraging worker bees work themselves to death looking for nectar, pollen, water, and propolis—a waxy substance from tree buds used to waterproof the hive. On the contrary, their northern sisters survive because they remain in the hive during winter months, making frugal use of their honey and pollen stores.

Bee "disappearing disease" began in 1962 in Texas, Louisiana, Alabama, and Mississippi. Coinciding with the dwindling of the hives, changing agricultural practices vastly reduced the acreage of pollen-producing pastures and woods (4 million acres were cleared for soybeans in Louisiana alone). Since bees pollinate more than $1 billion worth of valuable agricultural crops each year, any population loss affects agriculture and ultimately the consumer. In 1972 the production of honey was down to 215 million lbs. from 242 million lbs. in 1965.

Consumer demand for "natural foods" has increased the demand while production had declined. Thus the loss of colonies of honey bees through "disappearing disease" is critical to commercial and semicommercial beekeepers who depend solely or partially on honey bees for a living.

In Dr. Kauffeld's expirements, 24 colonies of honey bees were divided into 2 groups of 12 colonies each. In one group the queens were free, laying eggs at random and providing continuous brood rearing. In the second group the queens were restricted in a cage where they could be fed and groomed by the worker bees, but could lay eggs only in 4 square inches of the comb. From October to March each group received three different feeding treatments. They consisted of (1) normal foraging and no feed (2) normal foraging plus pollen and invert sugar (a mixture of glucose and fructose) and (3) normal foraging plus soybean meal and invert sugar.

By March the colonies with uncaged laying queens had increased in population; bees covered 13.6 frames of a standard hive compared to 10 frames in the fall. Colonies that received pollen and sugar in addition to normal foraging had slightly more brood than those fed soybean meal and sugar, or no food at all. Old bees were continously being replaced by young bees. Colonies with caged (brood restricted) queens had an average of only 2.3 frames of bees. Also, colonies with caged queens consumed less honey because of the lack of brood rearing, while colonies with uncaged (egg-laying) queens consumed more honey.

Bees are economical managers, says Dr. Kauffeld. In a field environment, they seem to sense the relationship between a scarcity of pollen and the amount they have stored. "When their 'salary'—nectar and pollen—is cut off," Dr. Kauffeld points out, "they use their 'savings'—stored honey and pollen—very sparingly. Worker bees put the queen, who's at their mercy, on a strict diet. What happens? She reduces egg-laying or stops entirely. They also force out the useless drones who only drink up the honey."

If nutrition is the key to brood rearing, then brood rearing is the answer to the problem of replacing aging bees. Disappearing disease, Dr. Kauffeld contends, is a misnomer. The condition can be prevented by feeding in the fall to replace the steady loss of bees in daily foraging during fall and winter. □

Fortified foods on the rise

MORE NUTRIENTS are being used to enrich and fortify a larger variety of foods, judging from the results of an ARS survey reported by Miss Berta Friend, food economist, Consumer and Food Economics Institute, Hyattsville, Md.

Use of ascorbic acid in foods increased two and a half times from 1967 to 1970, according to the survey, due partly to the trend toward fortifying beverages. At the same time, use of vitamin A in milk of all types nearly doubled. Use of vitamin B_6 and B_{12} in cereals more than doubled over a 5-year period ending in 1970, and use of vitamin B_6 for infant formulas, meal replacements, and other uses increased three and a half times.

Enrichment and fortification increased the estimated thiamin in the 1970 food supply by 40 percent; iron, by 25; niacin, 20; riboflavin, 15; vitamin A, 10; ascorbic acid, 10; vitamin B_6, 4; and vitamin B_{12}, 2 percent.

Research dividends

THE net monetary value of research to develop plant varieties resistant to Hessian fly, wheat stem sawfly, European corn borer, and spotted alfalfa aphid is about $3 billion over a 10-year period. That is a return of about $300 in reduced crop losses for each dollar invested by Federal and State agencies and private companies. This information comes from the publication, "Integrated Pest Management," prepared by the Council on Environmental Quality.

New biocontrol laboratory

RESEARCH on biological control of insects will have a new chance to move ahead when entomologists start work this month in a new laboratory at Newark, Del.

Beneficial insects obtained overseas will be shipped to this facility which ARS leases from the University of Delaware. Most of these imported insects will be parasites of pest insects. Even parasites are attacked by smaller parasitic insects, and it is the mission of the Newark laboratory to admit the "good" parasites and intercept the "bad" parasites.

Some of the insects obtained from abroad will be kept at the laboratory for biological control research. After a safety check, however, most of the new parasitic flies, wasps, and predatory insects—some 240,000 annually—will be sent to other Federal and State entomologists. These scientists will then use these parasites for their research and insect-control efforts.

The new laboratory replaces an older insect-quarantine facility at Moorestown, N.J., which has operated since the late 1920's. The Newark laboratory will provide 9,000 square feet of research and quarantine facilities—50 percent more than the old laboratory. Separate ventilation, heating, and air-conditioning systems for each isolation room will make the chance of insect escape virtually impossible. Steam sterilization will dispose of undesirable foreign insects and packing material. This treatment avoids pollution from the fumes and smoke created by burning such material.

Thirteen scientists and supporting staff will occupy the new laboratory. Its research program will include work conducted cooperatively with the Delaware Experiment Station.

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Zeroing in on knapweed

A SMALL European fly released in Oregon may bring the troublesome diffuse knapweed under control.

Diffuse knapweed is a hardy biennial herb which infests large areas of Oregon, Washington, Idaho, and Montana. This weed has become so firmly established on some range and crop lands that property values have dropped.

The fly was reared by the ARS Biological Control of Weeds Laboratory, Albany, Calif. Originally the flies that were released were collected from plants growing in France's Rhine Valley.

Entomologist Donald M. Maddox, who reared the flies at the Albany lab, is hopeful that knapweed will be brought under control in the Northwest once the fly becomes fully established. The flies severely damage the weed by laying eggs in the weed's flower heads. Later these eggs hatch and the growing larvae begin to eat the forming seeds. These larvae can cause up to 70 percent destruction of the seed head.

To start making a home for the flies, the men released about 200 flies in a 6x6x4-foot cage. After a week, they will remove the cage and the insects will be free to disperse from the caged area.

Feeding calves once-a-day

FEEDING CALVES milk only once instead of twice a day has no apparent ill affects, but the lack of care and attention may. That's what ARS animal geneticist Robert C. Lamb and, Utah Agricultural Experiment Station dairy husbandmen Ellis N. Roberts, and Charles H. Mickelson, recently found out in a comparison feeding study.

Calf scours and pneumonia among the calves fed once-a-day was not greater than normal, nor did any deaths occur. The once-a-day calves started eating grain sooner than the twice-a-day calves, however, and grew faster—1.46 lbs. per day as compared with 1.28 lbs. per day—up to 16 weeks of age.

The once-a-day system saved labor and gave desirable results, but scientists caution that calves under study received excellent care and very close attention by the herdsmen.

"The system is not recommended unless top-quality management and care is provided because of the vulnerability of young animals to sickness and disease," Dr. Lamb said.

Much ado about opaca

AN ARS PUBLICATION titled the "International Checklist of Cultivated *Ilex*," is making amateur and professional gardeners, especially holly fanciers, extremely happy.

For at last, in one place, they now have a valuable source of specialized information about one of the most widely grown American hollies, *Ilex opaca*.

A great deal of confusion has existed for many years on the correct nomenclature of these popular and distinctive plants. Adding to the confusion have been persistent differences of opinion on the plants' origins and even their descriptions.

The publication provides, for the first time, a listing of more than 1,000 cultivars of the *Ilex opaca*. It provides nurserymen, horticulturists, botanists, and amateur gardeners with a thorough description of these cultivars, as well as their origins, sources, and, when known, their hardiness ratings.

Listed as National Arboretum Contribution No. 3, the publication represents 9 years of intense cooperative effort between scientists at the U.S. National Arboretum and the Holly Society of America, Inc. Horticulturist Gene K. Eisenbeiss, and botanist Theodore R. Dudley, both of the Arboretum, Washington, D.C., conducted a meticulous search of the commercial, horticultural, and botanical literature for reference to hollies, and analyzed all holly names and pertinent data in the literature.

The checklist, which adheres to the 1969 International Code of Nomenclature of Cultivated Plants, will serve as an organized guide for updating and correcting names of cultivated hollies.

The scientists, however, are not resting on their holly leaves. They've already started on Part II of the worldwide listing of hollies.

When reporting research involving pesticides, this magazine does not imply that pesticide uses discussed have been registered. Registration is necessary before recommendation. Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife—if not handled or applied properly. Use all pesticides selectively and carefully.

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